THURSDAY, OCTOBER 12, 1882

A HISTORY OF COAL MINING

A History of Coal Mining in Great Britain. By Robert L. Galloway, Author of "The Steam-Engine and its Inventors." (London: Macmillan and Co., 1882.)

THIS unpretentious little volume of 273 pages contains a vastly greater amount of information of a useful and varied character than might at first sight be expected, and its author has evidently taken pains to collect the whole of his data from authentic and original sources. He has also succeeded to an eminent degree in welding them together into a concise, clearly written, and intensely interesting narrative. The twenty-three chapters into which the work is divided partly serve the purpose of marking more or less distinct epochs in the history of mining, partly pave the way for introducing accounts of inventions which have owed their origin to its ever-growing necessities. Prominent among these are the railway and the steam-engine, both of which were born and fostered amongst the coal-mines of Great Britain more than a hundred years before they began to revolutionise the world.

It would appear from Mr. Galloway's account that coal first began to be used as a fuel in some localities about the beginning of the thirteenth century. Much objection was raised against its introduction into London on the plea that its smoke was an intolerable nuisance. This opposition was continued for nearly two hundred years in some quarters, but was at last obliged to give way before the growing scarcity of timber. Towards the beginning of the fourteenth century many shallow collieries were opened out in the neighbourhood of Newcastle-on-Tyne, but little is known about the progress of our subject during the course of the fifteenth century. There is enough to show, however, that the demand for coal went on increasing. In a petition presented to the Council by the Company of Brewers in 1578 we find that corporation offering to use wood only in the neighbourhood of Westminster Palace, as they understand that the Queen findeth "hersealfe greatley greved and anoyed with the taste and smoke of the sea cooles." Another author writing in 1631 says that "within thirty years last the nice dames of London would not come into any house or room when sea coals were burned, nor willingly eat of the meat that was either sod or roasted with sea coal fire."

Soon after the commencement of the seventeenth century the use of coal for domestic purposes as well as for washing, brewing, dyeing, &c., was general and complete. The mines were still shallow, and they were drained by means of horizontal tunnels called adits, water-gates, &c. Already attempts had been made to sink some of them under the water-level and to raise the water by machinery. In the year 1486-7 the monks of Finchdale Priory expended a sum of money at one of their collieries on the Wear "on the new ordinance of the pump" and on the purchase of horses to work it. Underground fires and noxious gases began also to appear about this time. The miners' tools consisted of a pick, a hammer, a wedge, and a wooden shovel. The coal was raised to the surface in some cases by means of a windlass, in others, as in the mines of the east of Scotland, it was carried up stairs on the backs of women called coal-bearers. In the year 1615 the fleet of vessels called the coal-fleet, which carried the produce of the northern collieries—one-half to London the remainder to other destinations—numbered four hundred sail. Many foreign vessels also, especially French, carried away cargoes of coal to their respective countries. Twenty years later the coal-fleet had increased to six or seven hundred sail, and was already regarded as "a great nursery of seamen."

After the shallower seams were worked out the real difficulties of mining began. It became necessary to deepen the shafts and to greatly enlarge the area worked from each, and both of these circumstances entailed a more or less complete change in the character of the operations. Then it was that the great battle between inventive genius on the one hand and natural forces on the other hand began in earnest. The necessity for an improved means of transporting the minerals gave birth to the railway—probably about the beginning of the seventeenth century.

"Up till the year 1767 all the railways in the kingdom were constructed wholly of wood, with the exception of the employment of small bands of iron to strengthen the joints of the rails. But wooden rails were liable to rapid deterioration, and the demand for iron at Coalbrookdale happening to be slack in this year, it occurred to Richard Reynolds, one of the partners, that rails of cast-iron might be employed with advantage. A small quantity were accordingly cast as an experiment. They were four inches in breadth, an inch and a quarter in thickness, and four feet in length, and were laid upon and secured to the previously existing wooden rails. They were found to improve the railway so much that the same course was pursued with all the railways at the works. Between this period and the end of the eighteenth century considerable progress was made in the substitution of iron for wood in railway construction."

The inroads of water were first dealt with by means of buckets, then chain-pumps, then ordinary pumps. Horse-power was the common prime-mover, since wind-power was unreliable, and water-power could only be employed under exceptionally favourable circumstances rarely to be met with. As many as fifty horses were employed in raising water at some collieries. At the beginning of the eighteenth century Capt. Savery tried to introduce his fire-engine for raising water, but failed to do so.

"It was at this juncture" (1710), says our author, "that the miners had put into their hands the most wonderful invention which human ingenuity had yet produced—the Newcomen steam-engine, commonly called the 'atmospheric engine'; a machine capable of draining with ease the deepest mines; applicable anywhere; requiring little or no attention; so docile that its movements might be governed by the strength of a child; so powerful that it could put forth the strength of hundreds of horses; so safe that, to quote the words of a contemporary writer, 'the utmost damage that can come to it is its standing still for want of fire.'"

Towards the end of the seventeenth or beginning of the eighteenth century Sir Humphry Mackworth invented and successfully applied the process of coffering out or damming back water in shafts and sinking pits by means of a water-tight lining now called *tubbing*. He also con-

structed a railway at his colliery at Neath in Glamorganshire as early as 1698, but after it had been in use for eight years it was declared to be *a nuisance* by the grand jury at Cardiff, and part of it, which crossed the highway between Cardiff and Neath, was torn up and the rails cut in pieces.

Up to the beginning of the eighteenth century the air-currents which ventilated the mines were induced solely by natural causes. It was, however, customary to guide the current into the required channels by means of *stoppings*. As soon as the supply of air was found to be inadequate a new shaft was sunk. Fire-damp was now met with in considerable quantities in the deeper mines, and explosions, which destroyed many lives, began to take place. The first calamity of this kind on the Tyne occurred in 1705, when thirty lives were lost. In 1732 attempts were made in the North of England to produce artificial ventilation by the use of fire-lamps or furnaces, and these appliances were soon afterwards introduced into the collieries of the Tyne. Many disastrous explosions occurred during the eighteenth century and early in the present one, and some remedy was loudly called for. As early as 1733 flint and steel were being used for lighting in the Whitehaven mines, but it appears to be doubtful whether the steel-mill had then been invented. It is certain, however, that it had come into existence in 1753, when its inventor, Spedding, was referred to under the name of Prospero, in a poem in which Dr. Dalton calls it—

> "That strange spark-emitting wheel
> Which, formed by Prospero's magic care,
> Plays harmless in the sulphurous air,
> Without a flame diffuses light,
> And makes the grisly cavern bright."

The steel-mill was at the best a treacherous friend, and our author recounts the various incidents which led to its detection as such, and its abandonment. He also traces minutely the various steps which led to Sir Humphry Davy's splendid invention of the safety lamp in the end of the year 1815, and he gives what appears to be an impartial analysis of the claims put forward by, and on behalf of, George Stephenson to be the original inventor of a similar lamp at the same time.

"The discovery which Sir Humphry Davy had made, that explosion would not pass through small apertures and tubes, was only a stepping-stone to still higher achievements; and before the close of the year 1815 he gave to the world the *wire-gauze* lamp. This was the last, the most splendid, the crowning triumph of his labours—the 'metallic tissue, permeable to light and air, and impermeable to flame.'"

We must now, however, draw our review to a close without having so much as mentioned many another interesting topic which we hoped to have touched upon—such as the perseverance of Sir Robert Mansell, Vice-Admiral of England, in substituting coal for charcoal in glass making; the romantic struggles of Dud Dudley, son of Lord Dudley, against what seemed to be a relentless fate in his partially successful endeavours to effect the same change in iron making—but we can confidently recommend the reader to the original volume, where he will find much to interest him, much, it may be to profit him, and, we are sure, not a little to amuse him.

GARIEL'S "ELECTRICITY"

Traité Pratique d'Électricité, comprenant les Applications aux Sciences et à l'Industrie. Par C. M. Gariel. (*Premier fascicule.*) 200 pp., 140 figs. (Paris: Octave Doin, 1882.)

M. GARIEL, Professor of Physics at the École des Ponts et Chaussées, and better known in this country as the courteous and energetic secretary of the "Association Française," gives us in the above work the first instalment of an extensive book which will not be completed before next year. This first instalment is introductory to the whole subject, and deals with so much of elementary theory as the author deems requisite to give a firm grasp on his subject. Not rejecting mathematics, the author prefers to keep the mathematical treatment of his subject in the background. Nevertheless, he makes good use of algebraical footnotes, and by these and other evidences it may be judged that a firm scientific grasp will be maintained upon the various branches too often treated in a loose and unscientific manner.

Dismissing at the outset the notion that the work is intended for preparing for examinations, the author chooses from old and new the material that will best serve his purpose. It is very satisfactory to find modern notions, both in electrostatics and in electromagnetics, rapidly taking hold of the leading electricians of France. The treatise of M. Mascart first showed them how far electrostatics had advanced in the hands of Green, Gauss, Faraday, Thomson, Clausius, and Maxwell, beyond the achievements of Coulomb and of Poisson. The text-books of MM. Mascart and Joubert, and of MM. Jamin and Bouty, testify to the extension of this salutary influence. And now in the work of M. Gariel we have evidence of the same progress. For example, M. Gariel breaks free from servitude to the consecrated term "*tension*," so often misused as a synonym for potential, electro-motive force, and we know not what; but he uses it, not however in Maxwell's sense as denoting the mechanical stress along the electric lines of force, but as the electric force outside a closed conductor, or as the equivalent of $-4\pi\rho$. The ideas of Faraday on the nature of statical induction are evidently in M. Gariel's mind, though we think he does not give anything like an adequate attention to the subject of specific inductive capacity, which, though of immense practical importance, is passed over almost without mention. Indeed the faults of the book, if such we may call them in a work of such high scientific accuracy, are faults of omission rather than of commission. The contact-theory of voltaic action is very slightly sketched on p. 107; and on pp. 112–115 there is a discussion of the phenomenon of the variable state (*i.e.* of the gradual rise and fall in the strength of currents at making and breaking circuit), in which all allusion to the self-induction of the circuit is omitted, and which would probably lead a reader to draw the conclusion that the reason why the current did not at once attain its full strength was on account of bad conductivity of some part of the circuit. The portion devoted to Ohm's law is fairly complete; but we think the custom of bringing all resistances to a "reduced length" in the antiquated fashion of Pouillet is better honoured in the breach than in the observance. Amongst the newer topics introduced, and not often